

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 02-2C-C01-PV-B -X****SUBSYSTEM NAME:** FLIGHT CONTROL MECH – ELEVONS**REVISION:** 1 06/29/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:ELEVON ACTUATOR (INBOARD)	MC621-0014-0017
	MOOG	A20637-2
SRU	:POWER VALVE	A20569
LRU	:ELEVON ACTUATOR (OUTBOARD LEFT)	MC621-0014-0018
	MOOG	A20957-2
SRU	:POWER VALVE	A20892
LRU	:ELEVON ACTUATOR (OUTBOARD RIGHT)	MC621-0014-0019
	MOOG	A20536-2
SRU	:POWER VALVE	A20892

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

POWER VALVE (TWO PIECE END CAP ASSEMBLY)

QUANTITY OF LIKE ITEMS: 4

ONE PER ACTUATOR

FUNCTION:

METERS AND DIRECTS FLUID FLOW TO THE ACTUATOR PISTON. THE VALVE IS CONTROLLED BY THE COMBINED OUTPUT OF THE FOUR CHANNEL SERVOVALVES.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 02-2C-C01-PV-B- 05

REVISION#: 1 06/29/01

SUBSYSTEM NAME: FLIGHT CONTROL - ELEVON ACTUATOR

LRU: ELEVON ACTUATOR

ITEM NAME: POWER VALVE

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:

JAMMED

MISSION PHASE:

LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR
POWER VALVE WITH 2-PIECE END CAP ONLY

CAUSE:

MECHANICAL FAILURE, SEIZED (HYDRAULIC FLUID OVERTEMPERATURE), CONTAMINATION, EXCESSIVE SPOOL STOP MOVEMENT FROM POWER SPOOL END CAP

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) N/A
- B) N/A
- C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF ONE ACTUATOR FUNCTION.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE**NUMBER: 02-2C-C01-PV-B- 05****(B) INTERFACING SUBSYSTEM(S):**

LOSS OF CONTROL FOR ONE ELEVON SURFACE.

(C) MISSION:

POSSIBLE LOSS OF MISSION, CREW/VEHICLE. LOSS OF FUNCTION CAN RESULT IN LOSS OF VEHICLE CONTROL.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS (C)

-DISPOSITION RATIONALE-

(A) DESIGN:

SPOOL AND SLEEVE ARE 440C MATERIAL, HARDENED AND LAPPED FOR A MATCHED SET. SPOOL IS GROOVED TO CLEAR SILTING. POWER VALVE IS FILTERED WITH A 5 MICRON HYDRAULIC SYSTEM FILTER. FORCE DEVELOPED ON POWER VALVE SPOOL IS IN EXCESS OF 1,000 POUNDS TO CLEAR CONTAMINATION.

TWO SPOOL STOP CLOSURES ARE USED PER POWER VALVE TO LIMIT THE MOVEMENT OF THE POWER SPOOL TO 0.060" AT EACH END. THE ORIGINAL POWER SPOOL CLOSURE STOP WAS A TWO PIECE DESIGN CONSISTING OF A CRES STEEL SPOOL STOP PRESS FIT INTO AN ALUMINUM (6061-T6) END CAP. THIS TWO-PIECE CONFIGURATION HAD THE TENDENCY TO TRAP LUBE OIL/AIR BEHIND THE SPOOL STOP DURING THE PRESS-FIT OPERATION, MAKING IT DIFFICULT TO PRESS THE STOP COMPLETELY INTO THE END CAP. THIS MANUFACTURING ISSUE REPRESENTS A CONCERN, AS AN UNSEATED SPOOL STOP HAS THE POTENTIAL FOR FURTHER DISPLACEMENT FROM THE END CAP AND OVER TIME CAN RESTRICT THE FREE MOVEMENT OF THE POWER SPOOL. THE SUPPLIER (MOOG) RESOLVED THIS MANUFACTURING ISSUE IN 1983 BY INCORPORATING A FLAT ALONG THE CIRCUMFERENCE OF THE SPOOL STOP TO VENT LUBE OIL/AIR PRESSURE TRAPPED BETWEEN THE SPOOL STOP AND END CAP. CURRENT FLEET USES BOTH VENTED AND UNVENTED SPOOL STOPS. THE UNVENTED SPOOL STOPS DESIGN IS NO LONGER BEING MANUFACTURED AND WILL BE RETIRED BY ATTRITION.

(B) TEST:

QUALIFICATION: ENDURANCE CYCLING-400 MISSION DUTY CYCLES UNDER LOAD AT MAXIMUM TEMPERATURE OF 250 DEGREES F. ACTUATOR WAS VIBRATED AT FLIGHT LEVELS AND TESTED AT -65 AND 250 DEGREES F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 225 DEGREES F. SUPPLY PORTS WERE CYCLED FROM 3,000 PSIG TO 4,500 PSIG TO 1,500 PSIG, BACK TO 3,000 PSIG EACH CYCLE; RETURN PORTS, FROM 750 PSIG TO 1,500 PSIG TO 0 PSIG, BACK TO 750 PSIG. PERFORMANCE

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RECORD TESTS CONDUCTED AT 35 AND 225 DEGREES F FOLLOWING ENDURANCE TESTING. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE: PERFORMANCE RECORD AND POWER VALVE PRESSURE GAIN TESTS VERIFY THAT THE POWER VALVE IS OPERATIONAL. HYDRAULIC FLUID SAMPLES ARE TAKEN AFTER EVERY FLIGHT AND VERIFIED TO BE WITHIN SPECIFIED CLEANLINESS LEVELS. FLUID FROM ACTUATOR IS VERIFIED TO MEET CLEANLINESS LEVEL 190 PER MAO110-301.

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL CERTIFICATION ARE VERIFIED. SPECIAL MATERIAL REQUIREMENTS ARE IDENTIFIED IN CERTIFICATIONS.

NDE

PIECE PARTS EVALUATED BY SELECTED PENETRANT, MAGNETIC PARTICLE, ULTRASONIC, AND RADIOGRAPHIC INSPECTIONS.

SPECIAL PROCESSES

CRITICAL/CLOSE TOLERANCE DIMENSIONS AND FINISHES ARE 100 PERCENT INSPECTED FOLLOWING MACHINING.

CONTAMINATION CONTROL

ASSEMBLY AREA CLEANLINESS IS VERIFIED BY CONTAMINATION CONTROL PLAN. COMPONENTS ARE PRECLEANED PRIOR TO ASSEMBLY. PARTS AND TOOLS/AIDS ARE CLEANED PRIOR TO ASSEMBLY. END ITEM FLUID SAMPLE IS VERIFIED PRIOR TO ACTUATOR DELIVERY.

TESTING

ROCKWELL DESIGN AND QUALITY PERSONNEL, WITH NASA PARTICIPATION, CONDUCT A DETAILED ACCEPTANCE REVIEW OF THE HARDWARE AT THE VENDOR'S FACILITY, PRIOR TO THE SHIPMENT OF EACH END ITEM COVERED BY CONTROL PLAN. ATP VERIFICATION IS MIP FOR RI QA REPRESENTATIVE.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE.

(E) OPERATIONAL USE:

NONE

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- APPROVALS -

SAFETY ENGINEERING	: R. STELL	: /S/ R. STELL_____
SAFETY ENGINEERING ITM	: P.A. STENGER-NGUYEN	: /S/ R. STELL, FOR_____
HYDRAULICS ENGINEER	: W. VARGAS	: /S/ W. VARGAS_____
HYDRAULICS SSM	: S. NAMVARI	: /S/ S. NAMVARI_____
MOD	: J. DAVIS	: /S/ J. DAVIS_____
USA SAM	: M. J. BURGHARDT	: /S/ M. J. BURGHARDT_____
USA	: S. LITTLE	: /S/ J. WILDER, FOR_____